Coronavirus enteritis progression in cattle with mineral deficiencies

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Abstract. The article presents data on the shortage and content of trace elements in cattle, which leads to a wide range of pathologies, impaired reproduction, and a decrease in both dairy and meat productivity. The animal protection system, developed in the course of evolution to combat natural poisons, sources of man-made pollution and any animal disease, ultimately affects safety and productivity. The study of the development and prevention of the causes of these diseases, the effect of micronutrient deficiencies on the resistance of the animal body in the case of coronavirus infection, the development of treatment methods and preventive measures is an urgent problem today.

1 Introduction

One of the reasons for the development of a complex disease in cattle: coronavirus infection as a primary disease, enteritis as a secondary disease is micronutrient deficiency [1,2]. At the moment, coronavirus infection is an urgent problem for farmers, pastoralists, breeders, private entrepreneurs and people who own animals in all corners of our planet. This disease tends to adapt to environmental conditions, forming new strains that are difficult to treat and diagnose due to their specific adaptation mechanisms. This infectious disease causes especially great damage and harm to cattle, the owners suffer huge economic losses, resistance decreases in animals, dairy and meat productivity, animal deaths occur, but the most dangerous is the defeat of young animals [4,5]. Calves in 90% of cases die from this disease, unable to resist it, since the immune system is at the stage of development [6]. The situation worsens with the development of enteritis, as a secondary disease, against the background of a decrease in the body's immune response. Among the important components of animal nutrition, a significant place is given to minerals, including trace elements.

Ensuring effective protection of farm animals from diseases has been and remains one of the main tasks of veterinary science and practice. Only healthy animals can produce products of high sanitary quality. The most important veterinary measures include the

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prevention and treatment of non-communicable animal diseases and the prevention of poisoning [7].

In the modern world, general environmental pollution is increasing every day due to the intensive development of industry, the growth of cities as the most powerful sources of pollution, and the intensification of agricultural production [8,9].

Anthropogenic impact leads to a steady change in the natural geochemical distribution of trace elements in the biosphere, in particular, to the spread of biogenic toxicants in the environment, which in living organisms exhibit competitive properties in relation to essential trace elements. The main source of microelements in the body of animals are feed and water. At the same time, the level of intake of trace elements is mainly determined by the biogeochemical conditions that are characteristic of the animal habitat. This is due to the fact that the chemical composition of plants used for the manufacture of feed depends on the availability of trace elements in the soil [10].

Soils are characterized by a low content of copper, cobalt, iodine, selenium, and to a lesser extent zinc, and thus animals are at risk of developing microelementosis. Therefore, the study of the microelement status of animals and methods of its correction is of considerable interest [11].

One of the modern methods of diagnosing microelementosis in animals is the microelement analysis of the hairline, which characterizes the general elemental status of the organism, which is formed over a considerable period of time. In this regard, it is of interest to establish background concentrations of metals in animal hair in order to accumulate data on reference values for these indicators, including taking into account age and seasonal changes, as well as to monitor the correction of trace elements.

Therefore, the purpose of this study was to study the development and prevention of the causes of these diseases, to study the effect of micronutrient deficiencies on the resistance of the animal body in the case of coronavirus infection, to develop treatment methods and preventive measures.

2 Materials and methods

The research was carried out on 30 heads of cattle of the Ikryaninsky district of the Astrakhan region. The material for the study was morphological and biochemical parameters of blood, toxicological studies on the content of trace elements.

Sampling is carried out in accordance with generally accepted veterinary standards. To obtain representative data, it is recommended: Sampling in the morning, before feeding the animals; using sterile disposable vacuum tubes with a gel separator to collect serum; extracting blood from a vein (for example, from a jugularis vein) using needles of the appropriate caliber; ensuring minimal stress for animals during the procedure.

The collected blood samples are placed in test tubes and left at room temperature for coagulation for 30-60 minutes. After coagulation, the tubes are centrifuged at 3000 rpm for 10-15 minutes to separate the serum. The resulting serum is placed in sterile tubes and stored at -20 ° C until the analysis is performed.

Atomic absorption spectrometry (AAS) and inductively coupled plasma spectrometry (ICP) are used for the analysis of trace elements (Fe, Cu, Zn, etc.). The content of macronutrients (Ca, P, Mg) is determined using colorimetric methods and ion exchange methods.

The results are processed statistically using descriptive statistics (averages, standard deviations) and comparative analysis (t-test, ANOVA) to identify significant differences between groups of animals.

All data is recorded in laboratory journals, and the results are presented in tables and graphs for clarity. It is recommended that a report be prepared that includes the

methodology, results, conclusions, and recommendations for improving the mineral status of animals.

3 Results and discussion

The diagnosis was made on the basis of clinical and epizootological data and laboratory results: faecal samples, blood serum were taken to detect specific antibodies, and colostrum from lactating cows.

From general and biochemical blood analysis, as well as from general toxicological examination (trace elements and heavy metals) deficiency of calcium, iodine, cobalt, selenium and iron was revealed (Table 1). The lack of these elements led to a weakening of the animal's immunity, which reduced the body's resistance to diseases. The animal did not have enough resources to fight the infection, and this later led to complications.

Table 1. The content of trace elements (iron, selenium, iodine, cobalt, calcium) in the blood.

Trace elements	The average value for cattle	Reference values (mcg/%)
Iron	130	270 - 2930
Selenium	16	23 - 190
Iodine	1	5 - 20
Cobalt	0	0.1 – 0.4
Calcium	55	86 - 102

Since all indicators are in short supply, we will take the lower limit of the reference values as 100%. Thus, we get that iron is 52% lower than normal, selenium is 31%, iodine is 80%, cobalt is 100%, and calcium is 37%.

Calcium ions are among the most abundant in the animal body. They are found in bones, extracellular fluid, and soft tissues. The concentration of calcium in plasma is regulated by vitamin D and calcitonin. Based on the table, calcium is severely deficient in cows, which in this case manifests itself in impaired transmission of nerve impulses, impaired muscle contraction and blood clotting. Cobalt in the blood was not detected even in a small concentration. This is manifested by a violation of tissue respiration, a decrease in blood glycolytic activity. The iron level is within critical limits. This trace element is important for the animal body, as it is found in the liver, spleen, muscles, and bone marrow. In this case, iron deficiency is manifested by anemia. Iodine, through hormones synthesized in the thyroid gland, affects all types of metabolic processes in the animal body. Its deficiency is manifested by apathy, fatigue, shortness of breath, pallor of the mucous membranes. Selenium, which is in short supply, supports membrane functions, protein biosynthesis, and removes toxic substances from the body. The lack of this element is manifested by metabolic disorders and a decrease in body resistance.

Blood counts of these trace elements are below the norm, which indicates their deficiency.

In the treatment of coronavirus enteritis, infusion therapy, intramuscular and intravenous drugs were used at the first stage. At this stage, it was important to restore the body's resources to further combat the disease. For this purpose, the infusion solutions were

selected according to their composition (nutritional value and micronutrient saturation). Food was freely available to the animal, but no forced feeding was performed.

The second stage begins when the animal begins to eat on its own. At this stage, a suitable diet is selected and formed that will help gain weight, compensate for the lack of trace elements and vitamins, and fully provide the animal with all the necessary nutrients. The use of infusions is stopped, the use of injections continues until the livestock is fully recovered. In this case, feed additives were selected that contained calcium, cobalt, iron, iodine, and selenium. Vitamin preparations were also added to the diet.

The third stage is the observation of animals, regulation of temperature and light conditions, grazing, and diet. It is important to complete treatment, even if there are no signs of disease, as there is a possibility of recurrence. The animals' living conditions have been improved. The diet selected for the animals fully met all the needs of cattle, taking into account the peculiarities of the Astrakhan region. Blood was taken from the animals again for analysis, all trace elements and vitamins were within the normal range.

The animals were treated and monitored for a month. A relationship was found between a lack of iron, selenium, cobalt, iodine and calcium and a decrease in resistance in animals. The body could have avoided the development of a secondary disease, enteritis, if the microelement and vitamin levels of the blood were normal. The lack of these trace elements led to metabolic disorders. Our scientific team conducted a study to study the effect of these trace elements on the body (their role).We found out that iron performs a hematopoietic function, participates in the production of enzymes in the liver and spleen, participates in redox reactions of the animal body, participates in the development of the animal. Selenium participates in protein biosynthesis, participates in carbohydrate and lipid metabolism. Cobalt is responsible for the production of vitamin B12, affects reproductive function, and participates in energy metabolism. Iodine is involved in the production of the thyroid hormone thyroxine, participates in energy metabolism, and is responsible for the level of heat production in the animal's body. Calcium affects the activity of smooth muscles, participates in the synthesis of milk, and in the transmission of nerve impulses. All of these trace elements are involved in metabolism, so their deficiency leads to disturbances in metabolic processes and a weakening of the immunity of animals.

In this case, the lack of cobalt, selenium, iodine, iron, and calcium led to metabolic disorders. First of all, this led to a weakening of the animals' immunity. However, micronutrient deficiencies can lead to a number of diseases if the animal's habitat conditions are favorable and there are no sources of infectious and invasive diseases. We conducted a study in which we studied the effects of selenium, iron, iodine, cobalt and calcium deficiency in regions with the most favorable climate. The most widespread and rapid progression was shown by ketosis, endometritis, postpartum paresis, and displacement of the abomasum.

To optimize the mineral nutrition of animals, it is advisable to apply an integrated approach based on the consideration of the physiological needs of various species and age groups. First of all, it is necessary to conduct regular analyses of the mineral status of animals, which will reveal the deficiency or excess of certain micro- and macroelements. Based on the data obtained, the diet should be adjusted, including specialized feeds enriched with essential minerals.

An important aspect is the use of mineral supplements, which must be balanced according to the needs of specific animals. It is recommended to use premixes containing the necessary trace elements in a bioavailable form, which contributes to their better absorption. It is also necessary to take into account the influence of various factors such as age, physiological condition, productivity level and conditions of maintenance on mineral requirements.

Additionally, attention should be paid to the quality and composition of mineral nutrition sources. The use of natural mineral additives such as limestone, phosphorites, and salt can enhance the effectiveness of mineral nutrition. It is important to take into account that minerals can interact with each other, which requires careful selection of their ratios in the diet.

Animal health monitoring is equally important, as the presence of diseases can significantly affect the absorption of minerals. In this regard, it is recommended to conduct veterinary examinations and, if necessary, adjust the mineral nutrition depending on the health status of the animals.

In conclusion, in order to achieve optimal mineral nutrition, it is necessary to integrate the results of laboratory studies, dietary recommendations and practical observations, which will ensure the health and productivity of animals at a high level.Preventive measures include: selection of a complete diet for cattle. In this case, it is worth not only adding different crops to balance the nutrition of animals, but also adding vitamin supplements in cases where the region has special climatic or geographical environmental conditions. Compliance with annual vaccination, sanitary, veterinary and zoo hygiene measures. It is important to take this into account, since compliance with these simple rules is a guarantee that there will be no foci and outbreaks of infectious and invasive diseases among animals, their walking grounds and keeping. Proper and complete animal care. Rationed grazing of animals.

The lack of selenium, iron, cobalt, calcium and iodine combined to reduce the body's immune response, making animals more susceptible to diseases of viral etiology, namely coronavirus infection and enteritis. In this case, it was possible to avoid the death of animals, which would have caused economic losses. The animals have fully recovered in a short period of time.

4 Conclusion

Thus, micronutrient deficiency led to a decrease in the body's resistance (weakening of immunity), which allowed the development of not only the primary disease – coronavirus infection, but also a secondary one – enteritis. The body can resist this complex after the resumption of resources (vitamins and trace elements that are below the norm). Shortages can be avoided by making a proper and complete diet, controlling animal grazing, observing veterinary, sanitary and zoohygienic standards, and timely vaccination. It is very important to approach the composition of the diet and the quality of animal feed responsibly, since the formation of immunity depends on it, and in the future its maintenance.

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